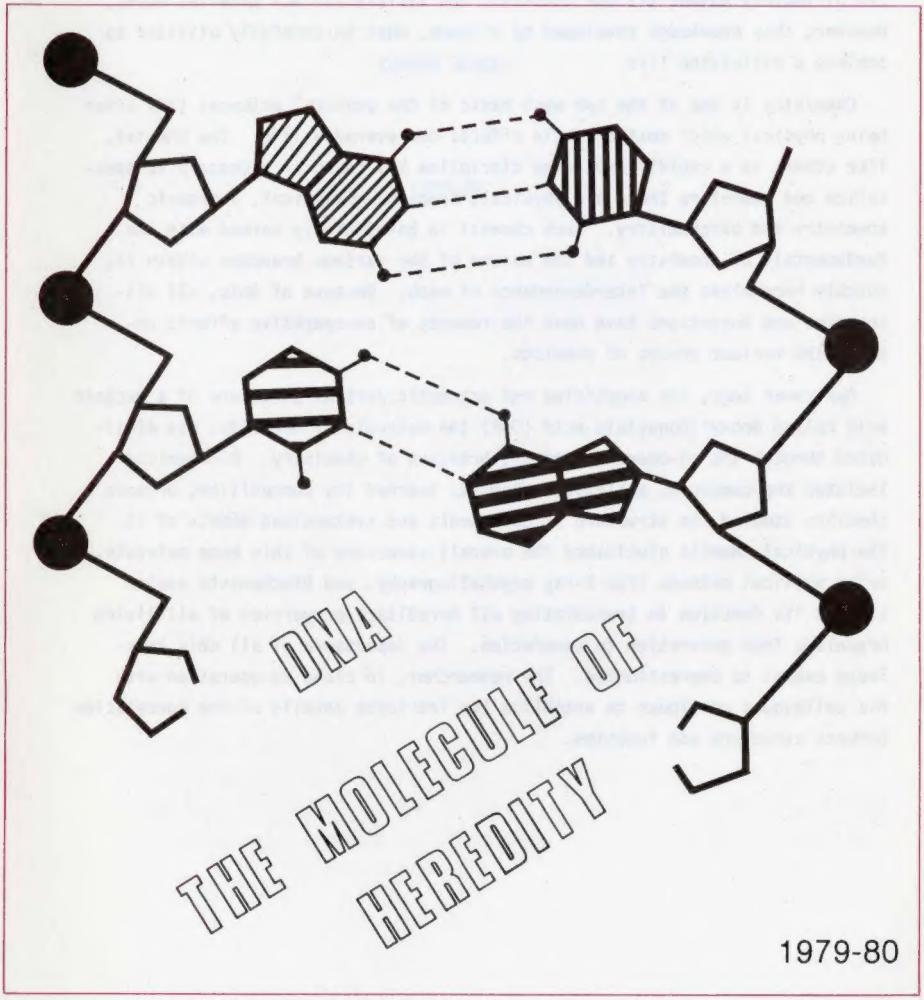
CONCORDIA UNIVERSITY

ARTS AND SCIENCE

CHEMISTRY



1979-80

SCIENCE OF CHEMISTRY

"The study of chemistry is profitable, not only inasmuch as it promotes the material interests of mankind, but also because it furnishes us with insight into those wonders of creation which immediately surround us, and with which our existence, life and development are most clearly connected." Justus von Liebig (1851)

We live in a scientific age which is so profound that some believe "science" can ultimately answer all our questions and satisfy all our material needs. However, this knowledge developed by science, must be carefully utilized to achieve a satisfying life.

Chemistry is one of the two most basic of the physical sciences (the other being physics) which most directly affects our everyday life. The chemist, like others in a rapidly expanding discipline has found it necessary to specialize and therefore there are physical, organic, analytical, inorganic chemistry and biochemistry. Each chemist in being highly versed with the fundamentals of chemistry and the nature of the various branches within it, quickly recognizes the interdependence of each. Because of this, all discoveries and inventions have been the rewards of co-operative efforts between the various groups of chemists.

Our cover logo, the simplified and schematic partial structure of a nucleic acid called deoxyribonucleic acid (DNA) the molecule of heredity, was elucidated through the co-operation of all branches of chemistry. Biochemists isolated the compound, analytical chemists learned its composition, organic chemists studied the structure of components and synthesized models of it. The physical chemist elucidated the overall structure of this huge molecule, using physical methods like X-ray crystallography, and biochemists again studied its function in transmitting all hereditary properties of all living organisms from generation to generation. The importance of all this knowledge cannot be overestimated. The researcher, in close co-operation with his colleagues continues to establish the intricate details of the correlation between structure and function.

CONCORDIA UNIVERSITY CHEMISTRY DEPARTMENT

COURSE GUIDE

1979-80

CHEMISTRY DEPARTMENT

COURSE GUIDE

1979-80

This booklet is intended to give prospective students an idea of programmes in the Department and a general course description. More detailed information may be obtained from the University Undergraduate Calendar Section 31.8.

TABLE OF CONTENTS

GENERAL INFORMATION

(i) Admission Requirements

(a) Quebec. Successful completion of a two-year, pre-university programme in a CEGEP with the award of a Diploma of Collegial Studies or its equivalent, satisfies the requirements for admission to the 90-credit undergraduate programme. Graduates of three-year technological programmes in CEGEP's are also admissable.

Specific courses must be successfully completed within the student's general CEGEP programme for admission to a particular department. The pre-university "profiles" (see below, "Chemistry Profile") have been established through joint action of the Quebec Universities and the Department of Education of the Province.

"CHEMISTRY PROFILE"

Mathematics 103, 203
Physics 101, 201, 301-78
Chemistry 101, 201
Biology 301

(b) Other Canadian Provinces

Non-Quebec applicants may be considered for admission to the 90-credit programme or an extended credit undergraduate programme. The duration of the programme will be determined by the entrance qualifications.

(ii) Registration

Registration for the September and January terms normally takes place in late August and mid-December respectively. Complete information is sent with the letter of acceptance.

(iii) Your Personal Contact.

All students interested in a Chemistry or Biochemistry programme should visit or contact one of the two student co-ordinators:

Loyola Campus	Prof. M. Baldwin (482-0320, Ex. 750)
S.G.W. Campus	Dr. K. Ekler (879-5964)

(iv) Scholarships, Awards, Medals, Prizes, etc.

Scholarships and prizes are given in recognition of academic achievements. Our graduates have an admirable record in being awarded N.R.C. and Centennial Scholarships. One of the two co-ordinators in the Department will advise you, on request, how to apply for these awards. In addition,

it is possible to obtain financial assistance in the form of bursaries and loans.

(iv) Departmental Facilities.

The Department has the necessary equipment and instrumentation to prepare our graduates for either industry or graduate school. The physical facilities are housed on:

(a) The Loyola Campus on the 2nd, 3rd and 4th floors of the Drummond Science Building located at the corner of West Broadway and Sherbrooke Streets (see page 5). Library facilities are conveniently located on the 2nd floor.

(b) The Sir George Williams Campus, on the 10th and 11th floors of the modern air-conditioned Hall Building located at 1455 de Maisonneuve Boulevard West (see page 8). Library facilities are conveniently located on the 10th floor, which include resource room, study area and audio-visual materials; open to all students in Chemistry. Modern calculating equipment is also available to all students in Chemistry.

STUDENTS ARE ENCOURAGED TO CONSULT AND CONFER WITH THE FACULTY.

FULL TIME FACULTY

Chairman

R.E. Townshend, Associate Professor

Professors

L.D. Colebrook

J.G. Dick

A. Graham, S.J.

T. Nogrady

J.R. Ufford

R.H.C. Verschingel

Associate Professors

T.J. Adley

P.H. Bird

M. Doughty

K. Ekler

Z. Hamlet

J. Lenoir

D. McElcheran

R.H. Pallen

R.T.B. Rye

N. Serpone

O.S. Tee

G.J. Trudel

R.A. Westbury

R.H. Zienius

Assistant Professors

M. Baldwin

M.G. Hogben

M.J. Kornblatt

J. Parkes

Special Lecturer and Research Associate

B. Pant

DRUMMOND SCIENCE BUILDING

THE AIMS OF THE TEACHING PROGRAMME

The programmes in Chemistry have clearly been designed to meet the specific needs of: (a) students who will make Chemistry their career; (b) students who intend to enter graduate school; (c) students who will complete their studies in other areas, but wish to have some knowledge of chemistry or work in chemically related fields.

The Framework of the Various Programmes

The various programmes in Chemistry have been conceived within a definite framework. They are as follows:

(a) Honours in Chemistry

A programme designed for students who plan to study chemistry beyond the undergraduate level. The programme is a demanding one, with high standards requiring the student to take 72 credits in specified courses out of the required 90 for a degree, in a set pattern.

(b) Specialization Degree in Chemistry.

A less intensive programme than the honours programme, but one which provides the student with an excellent grasp of the subject. The student is required to take 60 credits in Chemistry but numerous electives in Chemistry are available. On an interesting note, other electives may be taken in Humanities, Social Sciences and Commerce.

(c) Specialization Degree in Biochemistry:

With Options in Biochemistry and Medicinal Chemistry.
The Biochemistry programme is for students who wish to apply their knowledge of chemistry to biological systems. The student is required to take 72 credits in Chemistry and the Biological Sciences but a variety of electives are available in these subjects. The decision of which option to take, Biochemistry or Medicinal Chemistry is made only in the student's 3rd year.

(d) Specialization Degree in Analytical Chemistry.

This programme which requires the student to take 73 credits in Chemistry is specifically designed to enable a qualified student to work in analytical chemistry as applied in industry.

(e) Major in Chemistry.

Options: Chemistry or Biochemistry.
The student in such a programme is required to take 42 credits in an approved sequence. In such a programme, the student avails himself

of numerous options.

(f) Minor in Chemistry.

A 24 credit programme or 4 full courses. Such a programme leads to a Minor in Chemistry and can be arranged in consultation with one of the undergraduate advisors.

(g) Certificate in Scientific Measurement.

This particular programme requires the student to take 32 credits in Chemistry in specified courses. The programme is designed to meet a very specific need.

HALL BUILDING

AVAILABLE PROGRAMMES

Students are responsible for satisfying their particular degree requirements. The superscript indicates credit value.

NOTE: The Order of Chemists of Quebec has fully accredited the curricula of (i) Honours in Chemistry, (ii) Specialization in Analytical Chemistry; (iii) Specialization in Biochemistry; (iv) Specialization in Chemistry. Upon satisfactory completion of any of the above programmes, a graduate is eligible for membership in the Order of Chemists. A working knowledge of French is required.

BSc Honours in Chemistry (72 credits +)

Year I
CHEM C211^{6}, C221^{3}, C222^{3}, C231^{2}, C232^{2}, C233^{2}, C241^{3}, C242^{3},
MATH C220^{3}.

Year II
CHEM C311^{2}, C316^{1}, C321^{2}, C322^{2}, C329^{2}, C331^{2}, C332^{2}, C338^{2}, C339^{2}, C342^{2}, C348^{1}, C391^{3}, C310^{2}, and C315^{1}, or C314^{2} and C319^{1}.

Year III
CHEM C450^{6}, 3 credits of Physical Chemistry, 10 credits at the 400 level, (6 credits must be in one area).

BSc Specialization in Chemistry (60 credits +)

Year I
CHEM C211^{6}, C221^{3}, C222^{3}, C231^{2}, C232^{2}, C241^{3}, C242^{3},
MATH C220^{3}.

Year II
CHEM C321^{2}, C322^{2}, C329^{2}, C331^{2}, C332^{2}, C338^{2}, C339^{2}, C342^{2}, C348^{1}, C311^{2}, C316^{1}, C391^{3}, C310^{2}, and C315^{1}, or C314^{2} and C319^{1}.

Year III
3 credits of Physical Chemistry, 6 credits at the 400 level in one area. The nine credits required in Year III must include at least 2 credits of lab.

BSc Specialization in Biochemistry (72 credits +)

Year I
CHEM C211^{6}, C221^{3}, C222^{3}, C231^{2}, C234^{2}
BIOL C230^{3}, C270^{3}.

Year II
CHEM C311^{2}, C316^{1}, C321^{2}, C323^{2}, C329^{2}, C331^{2}, C333^{2}, C338^{2}, C339^{2}, C371^{6}.
BIOL C364^{3}, and C260^{3}or C336^{6}.

Year III
CHEM C434^{3}, C479^{3}, C470^{3}, C471^{3}, or C472^{3}.

BSc Specialization in Biochemistry (con't)

Biochemistry Option

400 level (3 credits)
3 credits chosen from CHEM C473[3], C474[3], C475[3].
3 credits in Chemistry at the 300 or 400 level.

Medicinal Chemistry Option

9 credits, CHEM C473[3], C474[3], C475[3].

BSc Specialization in Analytical Chemistry (73 credits +)

Year I
CHEM C211[6], C221[3], C222[3], C231[2], C232[2], C241[3], C242[3].
COMP C211[3], C221[3].

Year II
CHEM C310[2], C311[2], C312[2], C315[1], C316[1], C317[1], C321[2], C322[2], C329[2], C331[2], C332[2], C338[2], C339[2], C342[2], C348[1], C390[2], C399[1].

Year III
CHEM C314[2], C319[1], C419[6], C491[3], C498[3].
COMP C311[3].

BSc Major in Chemistry (42 credits +)

CHEM C221[3], C222[3], C231[2], C232[2], C241[3], C242[3], C211[6]
20 chosen from CHEM C310[2], C311[2], C312[2], C313[2], C314[2], C315[1], C316[1], C317[1], C318[1], C319[1], C321[2], C322[2], C323[2], C326[2], C327[2], C328[2], C329[2], C331[2], C332[2], C333[2], C334[2], C338[2], C339[2], C342[2], C343[2], C348[1], C371[6], C380[2], C390[2], C391[3], C399[1].
(Other courses may be selected in consultation with the Department.

BSc Major in Biochemistry (42 credits +)

Year I
CHEM C211[6], C221[3], C222[3], C231[2], C234[2],
BIOL C270[3].

Year II
CHEM C321[2], C323[2], C329[2], C333[2], C371[6].

Year III
CHEM C479[3]
6 credits chosen from C470[3], C472[3], C473[3], C474[3].

Minor in Chemistry (24 credits +)

CHEM C211[6], C221[3], C222[3], C231[2], C232[2], C241[3], C242[3]
2 credits chosen from Chemistry 300 level courses.

Other combinations may be arranged in consultation with the Department.

Certificate in Scientific Measurement (Chemistry Option)

(32 credits +)

CHEM C211[6], C310[2], C314[2], C315[1], C319[1], C390[2], C399[1], C490[3], C499[1]
PHYS C295[2], C296[2], C396[5], C397[5].

COURSE DESCRIPTIONS

CHEMISTRY C205

General Chemistry I

Stoichiometry, states of matter, atomic structure, electron structure of atoms, the periodic table, periodic properties, bonding, solids. Lectures, tutorials and laboratories. (3 credits).
NOTE: Science students may not take this course for Science credits.

CHEMISTRY C206

General Chemistry II

Prerequisite: Chemistry C205. Thermochemistry, solutions and their properties, equilibrium, ionic equilibrium, pH, buffers, kinetics, reaction mechanisms, other selected topics related to biochemistry, biology and engineering. Lectures, tutorials and laboratories (3 credits).
NOTE: Science students may not take this course for Science credits.

CHEMISTRY C211

Introductory Quantitative Analysis

Prerequisite: CEGEP Chemistry 201; CEGEP Physics 301, CEGEP MATH 103 and 203; or equivalent courses. Treatment of analytical data; chemical equilibria as applied to volumetric and gravimetric procedures; general theory of titrations and titration curves; neutralization, precipitation, complexation, oxidation-reduction and non-aqueous titrations, gravimetric analysis; potentiometry and potentiometric titrations; absorptimetric methods. Laboratory is taken concurrently and provides experience in the techniques of analysis discussed in the lectures. Lectures and laboratory (6 credits)

CHEMISTRY C221

Introductory Organic Chemistry I

Prequisite: CEGEP CHEM 201 or equivalent. Synthesis, structure and reactivity of saturated and unsaturated hydrocarbons. Elementary stereochemistry. Chemistry of benzene. Lectures and laboratory. (3 credits)

CHEMISTRY C222

Introductory Organic ChemistryII

Prerequisite: Chemistry C221 or one semester CEGEP Organic Chem. Synthesis, structure and reactivity of principal,functional groups. Simple reaction mechanisms. Lectures and laboratory. (3 credits)

CHEMISTRY C231

Introductory Physical Chemistry I

Prerequisite: CEGEP Chemistry 201; CEGEP Physics 301; CEGEP Math. 103 and 203 or equivalent courses. Real gases, equations of state (Van der Waal's, Virial, etc.), first law of thermodynamics, thermochemistry, entropy and the second and third laws of thermodynamics, free energy and chemcial equilibrium, electrochemical cells and the Nernst equation, use of activities, Gibbs-Helmholtz equation. Lectures only. (2 credits)

CHEMISTRY C232

Introductory Physical Chemistry II

Prerequisite: Chemistry C231 or an equivalent course. Applications of thermodynamics to one-, two- and three-component systems, including the properties of liquids, colligative properties, phase equilibria, kinetic molecular theory, chemical kinetics, the behaviour of electrolytes in solution. Lectures only. (2 credits).

CHEMISTRY C233

Introductory Quantum Chemistry

Prerequisite: Math. C220; CEGEP Chem. 201, CEGEP Physics 301 or equivalent courses. This course is intended to introduce the student to the fundamental ideas of quantum theory as applied to chemistry. Topics covered include the origins of quantum theory, the postulates of quantum mechanics, applications to simple systems, the hydrogen atom, other atoms, and simple molecules. Lectures only. (2 credits)

CHEMISTRY C234

Introductory Physical Chemistry for Biochemists.

Prerequisite: Chem. C231. Treatment of ideal solutions and solutions of macromolecules. Origin of macromolecules, and molecular weight determination. Transport processes; diffusion, sedimentation, electrophoresis. Chemical kinetics, photochemistry and radiation chemistry. Lectures only. (2 credits)

CHEMISTRY C241

Introduction to Inorganic Chemistry

Prerequisite: CEGEP Chem. 201; CEGEP Physics 301; CEGEP MATH. 103 and 203 or equivalent courses. The structure of the atom, ionic bonding; covalent bonding; chemical forces, acid-base chemistry; chemistry in aqueous and non-aqueous solutions. Lectures and laboratory. (3 credits)

CHEMISTRY C242

Chemistry of the Main Group Elements

Prerequisite: CEGEP Chem. 201; CEGEP Physics 301; CEGEP Math. 103 and 203, or equivalent courses. A survey of the properties and reactions of hydrogen, group 1A lithium to cesium, group 11A beryllium to radium group 111A aluminum to thallium, carbon, group 1VB silicon to lead, nitrogen, group VB phosphorous to bismuth, oxygen, group V1B sulphur to polonium, the halogens, the noble gases, group 11B zinc, cadmium, and mercury. Lectures and laboratory. (3 credits)

CHEMISTRY C280

Photographic Chemistry I

Prerequisite: Open to non-science students, preferably with some high school chemistry. This is a combined lecture and laboratory course in photographic chemistry. It is to be taken in conjunction with Physics C215/C217. Basic chemical principles in the study of the photographic process. Factors affecting the control of development

and some chemical reactions involved in the photographic process will be discussed and demonstrated. Lectures and laboratory. (3 credits).

CHEMISTRY C281

Photographic Chemistry II

Prerequisite: Chemistry C280. This is a continuation of Chem. C280. Manufacturing of photographic emulsion, developer composition, fixer composition, fixation and washing, reversal processing;mechanism of latent image formation and the theory of development will be discussed and demonstrated. Lectures and laboratory. (3 credits)

CHEMISTRY C282

Environmental Chemistry

Prerequisite: CEGEP Chem. 201 or equivalent. General aspects of environment and ecology; cycles in nature. The chemistry of pollution, air-pollution, water pollution, water treatment. Compounds treated: oxides of carbon, nitrogen and sulphur, hydrocarbons and types of particles. Photochemical and chain reactions. Mercury, lead, oil detergents, insecticides will be examined with regard to their chemistry and their contribution to pollution. Lectures only. (2 credits)

CHEMISTRY C310

Electrochemical Methods of Analysis

Prerequisite: Chem. C211; Chemistry C315 concurrently. Topics in theory and application involving potentiometry and potentiometric titrations; automated methods; polarization titrations; coulometry and coulometric titrations; electrogravimetry and electrolytic separations; voltammetry and polarography; pulse and sweep methods; amperometric titrations; conductometric techniques; chronopotentiometry and chronoamperometry. Lectures only. (2 credits)

CHEMISTRY C311

Introductory Analytical Organic Chemistry I

Prerequisite: Chemistry C211 and C222 or Chemistry C222 and 6 credits in Biology course(s) with laboratory, Chemistry C316 concurrently. Identification of organic compounds and trace impurities by chemical and instrumental methods. Discussion of analytical procedures, sample preparation and instrumental methods with emphasis on spectroscopic methods. Lectures only. (2 credits)

CHEMISTRY C312

Introductory Analytical Organic Chemistry II

Prerequisite: Chemistry C211 and C222 or Chem. C222 and 6 credits in Biology course(s) with laboratory; Chemistry C317 concurrently. Separation, purification and identification of organic components in chemical mixtures. Discussion of the basic principles of physical and chemical separations and related instrumentation, with emphasis on chromatographic methods. Lectures only. (2 credits)

CHEMISTRY C313

Environmental Pollution and Pollutant Analysis

Prerequisite: Chemistry C222 and any one of Chem. C211, C371, Biology C250; Chemistry C318 concurrently. Scope and purpose of environmental chemistry; nature and composition of natural waters; pollution and trace-level substances in water; water analysis; nature and composition of the atmosphere; atmospheric levels of the oxides of carbon, sulphur and nitrogen; organic, inorganic and particulate pollutants in the atmosphere; monitoring and analysis of pollutants in the atmosphere. Lectures only. (2 credits)

CHEMISTRY C314

Optical Methods of Analysis

Prerequisite: Chemistry C211; Chemistry C319 concurrently. Theory and application of absorptimetric, turbidimetric, nephelometric and fluorescence techniques; flame absorption and emission spectroscopy; electrical and plasma arc emission spectroscopy; atomic absorption flame and flameless techniques; X-ray fluorescence and diffraction methods; X-ray microprobe methods; radiochemical techniques. Lectures only (2 credits)

CHEMISTRY C315

Electrochemical Methods of Analysis Laboratory

Prerequisite: Chemistry C211; Chemistry C310 concurrently. Analytical experiments providing experience in the methods discussed in Chemistry C310. Laboratory only. (1 credit)

CHEMISTRY C316

Introductory Analytical Organic Laboratory I

Prerequisites: Chemistry C211 and C222 or Chem. C222 and 6 credits in Biology course(s) with laboratory, Chemistry C311 concurrently. Macro and semimicro separation techniques and procedures providing experience in the methods discussed in Chem. C311. Laboratory only. (1 credit)

CHEMISTRY C317
Introductory Analytical Organic Laboratory II

Prerequisites: Chemistry C311, C316; Chemistry C312 concurrently. Macro and semimicro separation techniques and procedures providing experience in the methods discussed in Chemistry C312. Laboratory only. (1 credit)

CHEMISTRY C318
Environmental Pollution Analysis Laboratory

Prerequisite: Chemistry C222 and any one of Chemistry C211, C371, Biology 250; Chemistry C313 concurrently. Analytical experiments providing experience in the pollutant analysis methods discussed in Chemistry C313. Laboratory only. (1 credit)

CHEMISTRY C319
Optical Methods of Analysis Laboratory

Prerequisite: Chemistry C211; Chemistry C314 concurrently. Analytical experiments providing experience in the methods discussed in Chemistry C314. Laboratory only. (1 credit)

CHEMISTRY C321
Organic Stereochemistry

Prerequisite: Chemistry C222, C232 or C234. Conformational analysis of acyclic and cyclic systems. Relationship to physical properties and chemical reactivity: Chirality, enantiomerism, diastereomerism, prochirality, enantiotopism and diastereotopism. Examples from steroid, carbohydrate and enzyme mediated reactions. Lectures only. (2 credits)

CHEMISTRY C322
Organic Reactions

Prerequisite: Chemistry C321 and C331 previously or concurrently. A mechanistic survey of reactions of major synthetic utility. Determination of reaction mechanisms. Importance of reactive intermediates: carbocations, carbanions, radicals and carbenes. Lectures only. (2 credits)

CHEMISTRY C323
Bio-Organic Chemistry

Prerequisite: Chemistry C321. Chemistry of Carbohydrates. Aspects of heterocyclic chemistry particularly as they apply to purines, pyrimidines and important coenzymes: pyridoxal, NADH, thiamine, flavines. Model enzyme studies. Lectures only. (2 credits)

CHEMISTRY C326

Natural Products

Prerequisite: Chemistry C222 or equivalent. Structure determination, synthesis and stereochemistry of various natural products. Examples from terpenes, carotenoids, steroids, alkaloids and antibiotics. Lectures only. (2 credits)

CHEMISTRY C327

Industrial Organic Chemistry

Prerequisite: Chemistry C222 or equivalent. Study of various industrial organic processes. Lectures only. (2 credits)

CHEMISTRY C328

Organic Chemistry of Polymers

Prerequisite: Chemistry C222 or equivalent, C232 or C234. Methods and mechanisms of polymer synthesis. Condensation polymerization, addition polymerization, ring opening reactions. Vinyl and diene polymers. Polyesters, polyamides, etc. Lectures only. (2 crs)

CHEMISTRY C329

Organic Reactions Laboratory

Prerequisite: Chemistry C322 or C323 previously or concurrently; Chemistry C331 and C332 or C333 previously or concurrently. Experiments with reactions of synthetic and mechanistic importance. Reactions involving reactive intermediates. Kinetic and thermodynamic control. Rearrangements. Laboratory only. (2 credits)

CHEMISTRY C331

Chemical Kinetics

Prerequisite: Chemistry C232 or C234. Topics in chemical reaction kinetics, including: mechanisms of elementary reactions; theories of chemical reaction rates; free radical reactions; factors influencing rates of reactions in solution; acid-base catalysis; catalysis by enzymes; the Michaelis-Menten mechanism; inhibition in enzyme catalyzed reactions. Lectures only. (2 credits)

CHEMISTRY C332

Intermediate Thermodynamics

Prerequisite: Chemistry C232 or C234. Comparison of closed and open systems. Partial molal quantities. Chemical potential. Real gases. Fugacity. Equilibrium constant. Free energy functions. Ideal

solutions. Real solutions. Duhem-Margules equation. Lectures only. (2 credits)

CHEMISTRY C333
Intermediate Physical Chemistry for Biochemists

Prerequisite: Chem. C234. Activities and standard states for non-electrolytes. Activities and activity coefficients for electrolytes. Electrical and magnetic properties of molecules. Basic electrostatic ideas. Dielectric behaviour. Circular dichroism. Optical rotatory dispersion. Fluorescence. Phosphorescence. Lectures only. (2 credits)

CHEMISTRY C334
Radiation Chemistry

Prerequisite: CEGEP Chemistry 201 or equivalent. A study of the chemical effects caused by ionizing and other nuclear radiations in their passage through matter. A description will be given of the quantitative measure of radiation energy absorbed, the energy absorption mechanism, the reaction paths of the unstable intermediates (excited molecules, radicals, and ions). A discussion of the mechanism for the radiation-induced dissociation of H_2O, organic compounds in the gaseous and liquid state and radiation effects in specific solids. Lectures only. (2 credits)

CHEMISTRY C338
Physical Chemistry Laboratory

Prerequisite: Chemistry C232 or C234. Experiments in physical chemistry, to illustrate some of the concepts studied previously, and to acquire basic dexterity in the physical chemistry laboratory. Laboratory only. (2 credits)

CHEMISTRY C339
Physical Chemistry Laboratory

Prerequisite: Chemistry C232 or C234. Further experiments in physical chemistry. The student will be expected to investigate more complex systems, and to write meaningful laboratory reports. Laboratory only. (2 credits)

CHEMISTRY C342
Chemistry of the Transition Elements

Prerequisite: Chemistry C241 and C242, C211. Coordination chemistry; structure, theory of bonding, reactivity of transition metal

complexes of various coordination numbers. Descriptive chemistry of transition metals of various oxidation states. Organometallic chemistry. Inorganic chemistry in biological systems. Lectures only. (2 credits)

CHEMISTRY C343

Industrial Inorganic Chemistry

Prerequisite: CEGEP Chemistry 201 or an equivalent course. Study of selected industrial inorganic processes. Lectures only. (2 credits)

CHEMISTRY C348

Inorganic Chemistry Laboratory

Prerequisite: Chemistry C342 previously or concurrently. Syntheses of coordination and organometallic compounds requiring various techniques. Determination of various properties of the compounds prepared at the laboratory bench. Laboratory only. (1 credit)

CHEMISTRY C371

Introductory Biochemistry

Prerequisite: Chemistry C222 and for Biochemistry students, C234. Fundamental aspects of biochemistry are surveyed. Protein structure and function, enzymology and enzyme kinetics. Carbohydrate metabolism: glycolysis, Krebs cycle, respiratory chain. Phosphogluconate pathway. Intermediary metabolism of lipids and proteins. Biosynthetic pathways of lipids, proteins, carbohydrates, amino acids and nucleotides. Nucleic acid structures and their function in protein synthesis; control of gene expression. Photosynthesis. Lectures and laboratory. (6 credits)

CHEMISTRY C380

General Industrial Chemistry

Prerequisite: Second year chemistry students or permission of the Department. Board outline of major factors to be considered by the chemical industry when contemplating manufacture of a new product or product group with special emphasis on market determination, customs, tariffs, use of Statistics Canada data, existing or potential competition, inherent advantages or disadvantages. Relative importance of labour versus capital; plant location; transportation considerations; by-product disposition; hazard and pollution considerations; government regulated products; government incentives. Marketing channels; exports considerations; foreign tariffs and non-tariff barriers. Lectures only. (2 credits)

CHEMISTRY C390

Introductory Instrumentation

Prerequisite: Chemistry C211 or two 6-credit Biology courses with laboratory. Chemistry C399 concurrently. Introduction to measurement principles, instrument design and basic techniques; analysis of basic modules in pH meters, potentiometric titrators, polarographs, gas chromatographs, photometers and spectrophotometers to emphasize facility in the use of similar instruments for measurement of specific systems. Lectures only. (2 credits)

CHEMISTRY C391

Chemical Spectroscopy

Prerequisite: Chemistry C222 and C232 or C234. General theories of spectroscopy: classical and quantum mechanical approaches, infrared, ultraviolet and proton magnetic resonance spectroscopy will be applied to the elucidation of structure of organic molecules. Rates and activation energies by pmr. Lectures, problem periods and laboratory. (3 credits)

CHEMISTRY C399

Introductory Instrumentation Laboratory

Prerequisites: Chemistry C211 or two full laboratory courses in Biology; Chemistry C390 concurrently. Basic RLC circuits, filters, semi-conductors, transistors, transistor amplifiers, difference amplifiers. Introduction to mechanical, optical and electrical transducers and recorders; signal-to-noise optimization, digital electronics, logic circuits and automation. Laboratory only. (1 credit)

CHEMISTRY C411

Advanced Analytical Organic Chemistry.

Prerequisite: Chemistry C311 and C312, C316 and C317; Chemistry C416 concurrently. Methods and techniques for the analysis of complex organic industrial formulations and natural products. Lectures only. (3 credits)

CHEMISTRY C416

Advanced Analytical Organic Laboratory

Prerequisite: Chemistry C311 and C312, C316, C317. Chemistry C411 concurrently. Experiments in the analysis of industrial formulations and natural products providing experience in the methods discussed in Chemistry C411. Laboratory only. (1 credit)

CHEMISTRY C419

Research Project and Thesis in Analytical Chemistry

Prerequisite: The student must be enrolled in the Specialization in Analytical Chemistry Programme. The student will work on a research project involving a theoretical and/or practical aspect of analytical chemistry, and will write a thesis on the results. The research project will be scrutinized by a committee of members of the Department. Experimental work and theory. (6 credits)

CHEMISTRY C421

Physical Organic Chemistry

Prerequisite: Chemistry C322. Theory and use of sigmatropic pericyclic and electrocyclic reactions. Woodward-Hoffman rules. Moebius-Hückel approach. Application to thermal and photochemical reactions. Introduction to organic photochemistry. Lectures only. (3 credits)

CHEMISTRY C422

Organic Synthesis

Prerequisite: Chemistry C322. Consideration of synthetic strategy and synthesis design. Modern synthetic methods and reagents. Exemplified by syntheses of terpenes, alkaloids, pheromones and novel structures. Lectures and laboratory. (4 credits)

CHEMISTRY C427

Industrial Synthetic Chemistry

Prerequisite: Chemistry C322. Selected study of industrial synthesis of fine chemicals, pharmaceuticals, dyestuffs, etc. Group assignments in scaling up laboratory syntheses to large scale, patent literature, toxicology, pollution and related industrial legislation. Lectures and laboratory. (4 credits)

CHEMISTRY C431

Statistical Thermodynamics

Prerequisite: Chemistry C331, C332 or C333. Elements of probability theory, microcanonical, canonical and grand canonical ensembles; Boltzmann distribution; quantum mechanical treatment of an ideal gas; Fermi-Dirac and Bose-Einstein statistics; Einstein and Debye models of a monatomic crystal; conformation of polymer chains. Lectures only. (3 credits)

CHEMISTRY C432

Selected Topics in Physical Chemistry

Prerequisite: Chemistry C331, C332 or C333. Subject matter will differ from year to year to take advantage of the special interest of the instructor concerned. The course will provide opportunities to senior students for discussion and advanced study in physical chemistry. Lectures only. (3 credits)

CHEMISTRY C433

Advanced Quantum Chemistry

Prerequisite: Chemistry C233, C332 or C333. This course deals with the theories of valence for both organic and inorganic materials. Topics covered include symmetry, construction and use of character tables, valence bond theory, molecular orbital theory, crystal field theory, ligand field theory. Lectures only. (3 credits)

CHEMISTRY C434

Advanced Physical Chemistry for Biochemists

Prerequisite: Chemistry C333. Thermodynamics applied to biological systems. Surface tension. Capillarity. Surface thermodynamics. Surface films. Adsorption. Electrocapillarity. Electrokinetic effects. Transport properties. Light scattering. Zimm plot. Lectures only. (3 credits)

CHEMISTRY C435

Physical Chemistry of Polymers

Prerequisite: Chemistry C332 or C333 previously or concurrently, C222. Physical properties of polymers; polymer solution theory; molecular weight distributions and fractionation; molecular determinations by colligative properties, light scattering and ultracentrifuge techniques; kinetics of condensation and addition polymerizations; copolymerization. Lectures only. (3 credits)

CHEMISTRY C436

Electrochemistry

Prerequisite: Chemistry C331 and C332 or C333. Thermodynamic relations in electrolyte solutions. Strong electrolytes. Electrolytic dissociation. Transport phenomena. Thermodynamics of electrode equilibria. Glass electrode. Electrical double layer. Dependence of electrode reaction rate on potential. Electro-chemical kinetics. Lectures only. (3 credits)

CHEMISTRY C439
Advanced Physical Chemistry Laboratory

Prerequisite: Chemistry C331, C332 or C333, C339. Advanced experimentation in chemical kinetics and thermodynamics with complete laboratory reports. Lectures and laboratory. (3 credits)

CHEMISTRY C441
Selected Topics in Inorganic Chemistry

Prerequisite: Chemistry C342. Selected topics in the field of Inorganic Chemistry chosen from current interest in this field. Particular topics may include: Organometallic Chemistry, Kinetics and Mechanisms of Inorganic Reactions, Electronic Spectroscopy of Transition Metal Complexes, Inorganic Photochemistry, Introduction to X-ray Crystallography and other current topics from the literature. Lectures only. (3 credits)

CHEMISTRY C442
Physical Methods in Inorganic Chemistry

Prerequisite: Chemistry C241 and C242; Chemistry C211; Chem. C391 previously or concurrently. Introduction to symmetry and the character tables. Diffraction methods, X-ray,ESCA, UV-Visible, ORD and CD, EPR, Moessbauer, NQR, NMR, IR and Raman. Lectures only. (3 credits)

CHEMISTRY C449
Laboratory in Synthesis and Techniques in Inorganic Chemistry

Prerequisite: Chemistry C442 previously or concurrently. Some of the techniques discussed in Chem. C442 will be employed in the laboratory to characterize and determine properties of compounds synthesized at the laboratory bench. Laboratory only. (1 credit)

CHEMISTRY C450
Research Project and Thesis

Prerequisite: Permission of the Department. The student will work on a research project under the direction of a staff member, and will write a thesis on the results. (6 credits)
NOTE: Students planning to take this course must consult with the Chemistry Department as early as possible the year before the final year.

CHEMISTRY C470

Proteins and Lipids Structure-Function Relationships

Prerequisite: Chemistry C371. Protein conformation in relation to muscle contraction and relaxation including ATP-myosin, actin-myosin and troponin-Ca^{++} interactions. Structure-function analysis of immunoglobulins and antigens: amino acid sequence, three-dimensional structure, antibody diversity, immunity, hypersensitivity, auto-immunity and graft versus host response. Biochemical and physical properties of lipids in relation to functions of biological membranes. Lectures only. (3 credits)

CHEMISTRY C471

Enzyme Kinetics and Mechanism

Prerequisite: Chemistry C371 and C331. Steady state kinetics including derivation of rate equations and the use of initial velocity studies and product inhibition to establish a kinetic mechanism. non-steady state kinetics, isotope effects, energy of activation, etc., methods used to study the role of amino acid residues in enzymic reactions; roles of various coenzymes and metals in enzyme mechanisms. Lectures only. (3 credits)

CHEMISTRY C472

Selected Topics in Biochemistry

Prerequisite: Permission of the Department. Selected topics in the field of Biochemistry chosen according to the interests of the instructor. Lectures only. (3 credits)

CHEMISTRY C473

Medicinal Chemistry I

Prerequisite: Chemistry C371. Types of drug action. Influence of physicochemical factors on drug activity, solubility partition coefficients, surface activity, molecular geometry, electronic properties, ionization. Receptor theory and methods, drug-receptor interactions of cholinergic, adrenergic and opiate drugs. Lectures only. (3 credits)

CHEMISTRY C474

Medicinal Chemistry II

Prerequisite: Chemistry C371. Theories of drug action. Survey of structure and mechanism of action of selected groups of drugs (e.g. antihistamines, diuretics, antibiotics, psychotropic drugs, steroids, pesticides, etc.) Drug design; modulation of drug metabo-

lism, transport, bioactivation by molecular modification. Antimetabolites. Lectures only. (3 credits)

CHEMISTRY C475
Pharmacology I

Prerequisite: Chemistry C371. Pharmacokinetics, drug metabolism and interaction. Toxicology, carcinogeneticy and teratogeneticy. Drug development and testing. Lectures only. (3 credits)

CHEMISTRY C476
Pharmacology II

Prerequisite: Chemistry C475. Autonomic nervous system pharmacology. Functions of central nervous system, depressant, stimulants. Narcotic analgesics, addiction. Cardiovascular, renal and endocrine pharmacology. Lectures only. (3 credits)

CHEMISTRY C479
Advanced Biochemistry Laboratory

Prerequisite: Chemistry C470, C471 or C472 previously or concurrently. This course deals with the theory and practice of modern biochemical laboratory techniques. Lectures and laboratory. (3 credits)

CHEMISTRY C490
Advanced Instrumentation

Prerequisite: Chemistry C390 and C399. Chem. C499 concurrently. Instrumental amplifiers, transducers and measurement errors. Analog, time and digital data domains. Optimization of electronic measurements, frequency response, sampling parameters, signal-to-noise enhancement. Micro processors for control, data acquisition and interface to computers. Lectures only. (3 credits)

CHEMISTRY C491
Advanced Spectroscopy

Prerequisite: Chemistry C321, C311 and C316 or C391; C498 concurrently. Theory and uses of NMR and EPR spectroscopies. Mass spectrometry: principles, fragmentation patterns, use in structure elucidation. Lectures only. (3 credits)

CHEMISTRY C498
Advanced Spectroscopy Laboratory

Prerequisite: Chem. C491 concurrently. Selected experiments to demonstrate the uses of NMR, EPR and mass spectrometry. Lab only (1 cr)

CHEMISTRY C499

Advanced Instrumentation Laboratory

Prerequisite: Chemistry C390 and C399. Chemistry C490 concurrently. Selected experiments to demonstrate the topics discussed in Chemistry C490. Laboratory only. (1 credit)